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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/976,067	10/12/2001	Chiou-Shian Peng	67,200-544	1571

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EXAMINER
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SAGAR, KRIPA

ART UNIT	PAPER NUMBER
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1756

DATE MAILED: 03/21/2003

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Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

Application No.

09/976,067

Applicant(s)

PENG ET AL.

Examiner

Kripa Sagar

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 12 October 2001.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-20 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 12 October 2001 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

### Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

### Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) \_\_\_\_\_.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_.

## **DETAILED ACTION**

### ***Specification***

1. Claims 1, 11 are objected to because of the following informalities: typographic errors.

In claim 1: l. 4 : "and thereon" should read "thereon";

l. 5: "and so that" should read "so that";

In claim 11: l. 5: "and so that" should read "so that"

Appropriate correction is required.

### ***Drawings***

2. Figure 1 should be designated by a legend such as --Prior Art-- because only that which is old is illustrated. See MPEP § 608.02(g). A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

3. The drawings are objected to because the figures do not conform to the specification.

Figs: 2E, 2F and 3B purportedly depict (according to the specification) a state where the photoresist (20) has been removed; whereas the figures actually show the resist in place.

4. A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

### ***Claim Rejections - 35 USC § 112***

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5. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claim 11 recites the limitation "after the hard bake step" in line 15. There is insufficient antecedent basis for this limitation in the claim.

The preceding step is claimed as a heating step; there is no reference to a hard bake step.

***Claim Rejections - 35 USC § 103***

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

7. Claims 1-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over US Pat.6179200 to Kung et al in view of US Pat.5251806 to Agarwala et al. and further in view of the non-patent publication of Gilleo (Area Array Packaging Handbook).

The claims recite methods of increasing the height of a solder bump by additional depositions of second and third metallurgies. Photolithography, electro- and electroless- plating techniques are used. The claims further recite process steps and materials including sputter cleaning the pads, electroplating conductive layers, electroless-plating the third layer and using solder Cu, Ni, Ag or Au as plating materials.

Kung teaches most of the elements of claims 1- 20. It teaches an underbump metallurgy (UBM / BLM) wherein the contact pad is exposed through a passivation and BLM layer. A solder mass is formed over the BLM by photolithography. and reflowed.

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The photoresist is removed and the BLM is etched and the solder is reflowed. This is well-known prior art (Fig. 2). It teaches that the solder mass may be deposited by electroplating or electroless plating (5,24-35). Kung teaches sputter cleaning the pads (Fig. 1).

Kung does not teach increasing the height of the solder layer by depositing additional layers of metals. It does not specifically teach flux-cleaning the solder surface. Kung teaches that the filling material may be solder of any composition but does not specify Cu or Ni as the second layer ; it does not specify electroless plating of Cu, Ni, Ag or Au as the third layer. It does not specify hard baking the resist. However hard-baking photoresist is an integral step of photolithography and would have been obvious to one of ordinary skill in the art.

Agarwala's invention is also aimed at increasing the heights of solder bumps. Agarwala teaches stacking multiple layers of solder to increase the bump height. It teaches multiple layers of metals deposited over lower layers. It teaches the use of Cu, Ni or Au as barrier materials between the layers (6;32-36) to increase the wettability of the subsequent layer or as an encapsulating layer. The layers do not contribute to the height of the bump.

Neither Kung nor Agarwala teaches cleaning the surface with flux. This is a standard procedure in soldering as one skilled in the art would know and is taught by Gilleo ( Sec.1; ch.7.4.1). Gilleo teaches diverse solder compositions and properties including the use of Ni and Au for fusible and non-fusible bumps (ch. 13-15)

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It would have been obvious to one of ordinary skill in the art at the time the invention was made to form multilayered solder metal stack as taught by Agarwala, with the art-accepted materials and processes taught by Gilleo, using the photolithographic method known in prior art (Kung) because Kung teaches the need for increasing the bump height (3;12-20) and Agarwala teaches that the method increases the solder joint reliability ( 8; 21-30) while Gilleo teaches that flux cleaning facilitates solder adhesion (Sec.1;ch:7.4.1)and the use of Ni, Cu, Au and Ag are known to improve solder mechanical and wetting properties (sec.1 ch;7.2.1, ch:7.2.2 & sec.2 ch:13,14,15).

8. Claims 1 and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over US Pat.6426281 to Lin et al. in view of US Pat.6204557 to Yanagida and further in view of US Pat.6426176 to Danielson et al. and further in view of US Pat. 6440836 to Lu and further in view of US Pat. 6391034 to Stuby.

Lin teaches increasing solder height by forming bumps of multiple layers of metals. A photolithographic method is used to form the UBM and solder-bump. This is known-prior art (Fig.1-4, 5-10). It teaches that hard baking of photoresist, flux-cleaning of metal surfaces prior to soldering are standard procedures known in prior art (2;14-65). It teaches that in addition to increasing bump heights, metal layers may be added to provide diffusion barriers and to improve wettability. Cu and Au may be used. (2;66-3;17). In the inventive method, Lin teaches electroplating multiple layers of metals (46,48,50) in a resist opening to form the bump (fig.14,15,16). The layers are hard-baked and the photoresist is removed ( 10;4-10). The upper layer of solder is reflowed (Fig.17). The pads are sputter cleaned prior to bumping (7;28-30).

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The teachings of Lin differ from the instant claims in that the diverse metals (Cu, Ni, Au ) are plated in a different sequence. They serve to increase the bump-height. Lin does not teach depositing metal on solder. It does not teach electroless plating.

Yanagida solves the same problem as Lin--to increase solder bump height. It teaches forming a solder bump and subsequently increasing its height by plating a second solder (fig.1,2 & 9;46-50). It teaches that each of the bumps may be formed of different metals. It teaches Au-plating on Ni or Cu (7;45-62).

Yanagida does not teach plating Au on solder.

Danielson teaches plating Cu, Ni, or Au over solder (Fig.3 & 3;53-59).

Danielson does not teach electroless plating.

Electroplating and electroless plating of solders is common in the art; this is taught by Lu (8;57-63).

Lu does not teach sputter cleaning the pads.

Stuby teaches that solder pads may be sputter etched prior to metal deposition (4;35-49).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to form multiple layers of metals to increase solder bump height as taught by Lin, using the pre-cleaning technique of Stuby and depositing diverse metals layers taught by Yanagida and Danielson using the plating techniques of Lu because Stuby teaches that sputter cleaning removes the oxide layers on the pad and is known to improve the adhesion of the deposited metal (1;45-51); Lu teaches that electroless plating and electroplating are common in the art and that there is a reasonable

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expectation of successfully forming solder bumps using either method (4;56-57) ; and Yanagida and Danielson teach that Cu, Ni, Ag and Au are routinely plated on solder to provide different properties such as increased wettability, reliability ( Yanagida 1;41-44 & 7;11-17) or increased conductivity Danielson (1;54-58).

### ***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Kripa Sagar whose telephone number is 703-605-4427. The examiner can normally be reached on M-F.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark F Huff can be reached on 703-308-2464. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9310 for regular communications and 703-872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0661.

MH/ks  
March 17, 2003

  
MARK F. HUFF  
SUPERVISORY PATENT EXAMINER  
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